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AVAILABLE TESTS AND THEIR USE IN RESEARCH IN VOCATIONAL EDUCATION.

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MEASUREMENT OF INDIVIDUAL TRAITS AND SEPARATE FACTORS OF INTELLIGENCE FOLLOWED BY EMPIRICAL COMBINATION OF THESE MEASURES INTO APTITUDE TEST BATTERIES SHOULD BE THE BASIS OF SELECTION OF STUDENTS FOR VOCATIONAL TRAINING. DURING THE PAST 14 YEARS, TRADE-TECHNICAL COLLEGE HAS DEVELOPED AND VALIDATED SUCH TEST BATTERIES FOR SOME 55 TRADE AND TECHNICAL CURRICULUMS, TESTING OVER 8,000 APPLICANTS ANNUALLY. THE STUDENT-SELECTION PROCESS INVOLVES BOTH THE TESTING PROGRAM AND AN APPLICANT-COUNSELOR-INSTRUCTOR INTERVIEW. VALIDITY STUDIES MADE ON THE APTITUDE TEST BATTERIES, AND THE TESTS FOUND TO BE PREDICTIVE, ARE PRESENTED IN TABULAR FORM. SIGNIFICANT CORRELATIONS ON APTITUDE TESTS AND INSTRUCTOR GRADES, MEANS AND STANDARD DEVIATIONS, AND OTHER PSYCHOMETRIC DATA ARE GIVEN. (HS)

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AVAILABLE TESTS AND THEIR USE IN RESEARCH IN VOCATIONAL EDUCATION

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AVAILABLE TESTS AND THEIR USE IN RESEARCH IN VOCATIONAL EDUCATION

Margaret L. Crawford, Ed.D.

Introduction

It is a rare privilege to meet with such a distinguished group of educators and to participate with you in this Seminar on Tests and Measurements at Colorado State University.

The selection of students for vocational training is a matter of great concern and it is most encouraging that you are directing your interests to this problem. As you pursue your research studies and as you prepare tomorrow's leaders in the teaching fields, your point of view, your decisions and your influence in this vital aspect of vocational training can affect decisively the outcome of vocational selection for many years to come.

The materials I am presenting to you today are based upon some fifteen years of testing and research in the selection of students for vocational education at Los Angeles Trade-Technical College. Using a core of standardized tests, we have developed aptitude test batteries to assess the potential of applicants for some fifty-five trade-technical and business curricula. Our experience indicates that the IQ tests so generally used in the elementary and secondary schools and the scholastic achievement tests so generally used in combination with high school grade point average to predict college achievement are not the best predictors for success in vocational classes. They appear to be of limited value in the selection of vocational trainees.

Our research leads us to the conclusion that measurement of individual traits and separate factors of intelligence followed by empirical combination of these measures into aptitude test batteries specifically designed and weighted to predict success in specific areas of training within a specific

institution is a far better approach to the problem. This is a plea, then, for trait and factor theory as the basis of the selection of students for vocational training.

Industry and educational institutions now using standardized group tests as an economical and practical method of selecting potential trainees have the test-makers of World War I and II to thank for the development of such instruments. During World War I, these early workers, faced with the problems of testing thousands of recruits daily, developed the idea of administering standardized tests in a group situation. From this work has stemmed a continuing production of hundreds of standardized group tests of intelligence, aptitude, personality, interest and special abilities.

It was formerly considered sufficient to know a man's score on one of the "intelligence tests" in order to predict his success in a trade field. Minimum standards of the time were a Binet mental age of 14, a score of 26 on the Otis Higher Ability (20 minutes), an Army Alpha score of 63 or an Army Beta score of 70, and a Stanford Binet of 92 for average trades and of 84 for the trades of a less demanding nature.

Workers in the field of testing and counseling have long been concerned with the labeling of adolescents on IQ tests when observation has shown that many of those persons discriminated against by the verbal facility required in these tests, can actually perform at a high level of skill in such non-verbal areas as dexterity, ability to see details, make judgments and visualize objects. Certainly the ability of a great surgeon depends in large part upon some of these same skills. What is intelligence, then?

Some light was thrown on the subject by the work of Spearman, who hypothesized a central core of knowing and seeing, a General Factor or G Factor of intelligence plus an unknown number of specific factors.

Later, Thorndike postulated three intelligences - not just one - differentiating among abstract, mechanical and social intelligences. This work still hypothesized a group factor of mental organization.

Some eighteen years ago a most thought-provoking report was made in the area of defining intelligence. It grew out of the work of an eminent group of psychologists, psychiatrists and psychoanalysts during World War II. I refer, of course, to the report by the Office of Strategic Services called the "Assessment of Men". The O.S.S. Staff would correlate the "term intelligence with the effectiveness of any system of mental functions". They would "designate the nature or purpose of each distinguishable system by an appropriate adjective such as aesthetic intelligence, social intelligence, scientific intelligence, administrative intelligence". They would then "designate by a suitable term each separate function that is involved in the operation of each system such as observational ability, evaluative ability, interpretive ability, memory ability, conceptual ability, imaginative ability, logical ability, predictive ability, planning ability, et cetera, et cetera".

This is, of course, an extension of the ideas of Thorndike, and this broad concept of the intelligences of man along with the advent of factor analysis techniques, has led to the rationale behind trait and factor theory and the development of uni-factor tests of relatively pure abilities by distinguished workers in the field, notably the Thurstones, Guilford, Flannagan, King, Ruch, those associated with the U. S. Civil Service, the Armed Services and others.

Hahn and MacLean in their book General Clinical Counseling have further analyzed five of these intelligences. They deal with academic, mechanical, social, clerical and aesthetic or artistic intelligences. The clusters of abilities related to these systems appear to be:

Academic - Ability to understand and manage ideas and symbols - varying occupational levels include the professions, executives, technical, clerical and supervisory, skilled trades and lower level clerical workers.

Mechanical - Ability to manipulate concrete objects, to work with tools and machinery and materials and to deal mentally with mechanical movements - dexterity, spatial visualization, reasoning, visual acuity (in some cases color vision) and interest in mechanical things seem pertinent. Varying occupational outlets range from high level technology and engineering through the technical, skilled trades and unskilled levels.

Artistic - The capacity to create in art forms and to recognize the artistic value of created forms. Such abilities as eye-hand coordination, visual acuity and depth perception, spatial visualization, reasoning and a sense of proportion seem indicated. Color sensitivity may be involved. Vocational outlets range from creative artist through illustrator, fashion designer, draftsman, landscape gardener, potter and weaver, among others.

Clerical - The ability to rapidly and accurately check details, measure, classify, record, proofread materials and compute using mechanical devices and data processing equipment. Vocational outlets range from accountants, secretary, bookkeeper, stenographer, calculating machine operator to file clerk and general office assistant.

Social - The ability to deal successfully with people, to understand and be sensitive to their needs, and to initiate procedures for managing people which incorporate the principles of good human relations. Levels of vocational outlet include politicians, religious leaders, social service workers, executives, physicians, salesmen and clerical personnel responsible for information services.

The O.S.S. Staff has warned that "if it (intelligence) be confined in its application to a particular kind of mental ability (such as academic, abstract and scholastic) the social consequences of this development may be considerable". The idea that there is only one kind of intelligence and the placing of value alone on the power to handle verbalization and abstraction of the sort that point only to reading books, writing reports, and success in the formal education pattern leads toward an intellectual aristocracy, in the opinion of Dr. Malcolm MacLean in his article in Education on "Intelligences - Not Intelligence - Implications for Counseling". Dr. MacLean sees this philosophy of the Great Books people as leading to the collapse of democracy and control over the masses of men by the scholastics and - for counseling - a return to the old "academic minded" and "hand minded" dichotomy.

The same writer states that "if the O.S.S. concept of many kinds of intelligences, each supported by multiform clusters of supporting abilities, interests, attitudes and value systems is accepted, we get a sharply different social consequence. Here lies the road to true democracy". The result of this philosophy is that every man's talent would be developed to its fullest for his personal satisfaction and greatest service; that we would cease to compare the incomparable such as the value of a good surgeon as against the

value of a good mechanic instead of comparing one surgeon with another, or one artist with another artist, and lastly, we would cease, on the basis of the notion of a single intelligence, to credit universal wisdom in all matters to the wearers of the Phi Beta Kappa or Sigma Xi key. Rather, we would give deference to the ideas of these outstanding men according to their accomplishments and their pronouncements in the fields of their research.

We have a long way to go in our testing for these special abilities. At present, the percentage of these tests to the total tests in Buros is still small. But change is coming - work is going forward in the imaginative or creative thinking field. As Dr. MacLean points out, "We must incessantly work at the idea of intelligences rather than intelligence, going through finer and finer differentiation at the same time that our main job must always be the synthesis and integration of these manifold factors in the main job of assessing and helping human beings."

Aptitude Testing

In 1950 Los Angeles Trade-Technical College began a testing and guidance program based upon the approach that man possesses many different kinds of intelligences and that these intelligences are identifiable and measurable by standardized tests of relatively "pure" abilities. Using job analysis, the necessary intelligence factors for success in specific occupations are determined. Aptitude tests measuring these specific factors are combined then into aptitude test batteries to assess an individual's potential for specific occupations.

During the last fourteen years Los Angeles Trade-Technical College has developed and validated such aptitude test batteries for some fifty-five trade and technical curricula. Testing over 8,000 applicants annually, norms are now of considerable size. The test batteries are derived from a core of

twenty-one separate tests measuring various factors. Batteries are constantly subject to check, revision and improvement.

As an example of the program, let us take the development of the aptitude test battery used for the selection of Electronic Technicians. Job analysis revealed that the technician inspects and fits parts, makes calculations, reads prints and schematics, trouble shoots and works with others on a team.

A check on the psychological factors involved in successful performance revealed that measurement of verbal ability, space visualization, numerical facility, reasoning, dexterity and certain personality traits might be indicated. An experimental battery was administered to incoming trainees. Such a battery will contain more tests than the final battery developed from it.

Upon completion of the training period, instructor ratings of student performance in the course were correlated with aptitude test scores. The factors chosen for the final battery were those showing the greatest relationship with the teacher ratings and the least correlation with each other. Beta weights are determined by the Doolittle method and a conversion table changing all possible raw scores to standard weighted scores is developed. A percentile table is developed based on the total battery scores of the experimental groups, and ratings of high, middle and low are determined from above the 66th, between the 66th and 33rd, and below the 33rd percentile respectively. The cutting score is the 33rd percentile. Using the scores of fifty-five students, the following factors were selected for the final battery:

Science Research Associates, Mechanical Aptitudes Shop Arithmetic	r_{bis} .40
Guilford-Zimmerman Aptitude Survey, Part 6 Spatial Visualization	r_{bis} .43
Progressive Matrices (Non-speeded and non-verbal reasoning)	r_{bis} .43
Primary Mental Abilities Word Fluency	r_{bis} .38

This aptitude test battery administered to beginning students and requiring one and one-half hours of testing time, was found to have the correlation Multiple R .68 between the total battery scores and performance ratings of class achievement as determined by grades at course completion.

The selection process used involves both the testing program and an applicant-instructor-counselor interview. In the latter such factors as health, age, work experience and training are considered. In general, those applicants are accepted for training who make a total battery score equivalent to a total battery score at the 33rd percentile or above based on norms developed on the experimental group. Those applicants scoring below this cutting point are referred for further counseling. Such applicants are encouraged to investigate other offerings of the college more consistent with their abilities. Some may be counseled toward adult education classes to improve basic skills and then return for retesting at a later date. Each person tested receives the benefit of an individual review of his test results through the interview with the counselor and an instructor teaching in the curricula for which the applicant has tested.

The testing and guidance program at Los Angeles Trade-Technical College has been successful. Teachers feel that they are getting "better" students; they know more about the potentials of their students (the files are open to them while working with a counselor); there are fewer class interruptions; dropouts have decreased materially and criticism of discrimination is practically non-existent.

The counseling service is available to those who have chosen an occupation, to those who have not yet discovered their vocational interests and to those who find it necessary to retrain for another occupation.

Our experience leads us to believe that this method is valid for selecting vocational students. Cross-validation studies reveal that similar

intelligence factors are predictive of success in similar courses offered at other institutions. However, while norms on individual tests are useful from school to school, the weighted total battery score will be useful only in the institution where the regression equation data are obtained due to variability in criteria.

The following validity studies made on the aptitude test batteries and the tests found to be predictive are presented for your consideration.

LOS ANGELES TRADE-TECHNICAL COLLEGE
GUIDANCE DEPARTMENT
January 1964

SIGNIFICANT CORRELATIONS
APTITUDE TESTS AND INSTRUCTOR GRADES

AIRCRAFT MECHANIC N = 119

Test	Correlation r_{bis}
Primary Mental Abilities	
Verbal	.19*
Space	.29**
Reasoning	.29**
Word Fluency	.21*
Progressive Matrices	.38**
SRA Mechanical Aptitudes	
Shop Arithmetic	.26**
Guilford-Zimmerman Aptitude Survey	
Part 6 - Spatial Visualization	.38**
Part 7 - Mechanical Knowledge	.34**
Guilford-Zimmerman Temperament Survey	
'M' Factor	.28**

Battery Used:

Progressive Matrices
SRA Shop Arithmetic
G-Z Spatial Visualization
G-Z Mechanical Knowledge
PMA Verbal

Validity Check:

N = 124 Aircraft Power Plant Mechanic	r_{bis} .53**
N = 119 Aircraft Airframe Mechanic	r_{bis} .58**

Level of significance ** 1%, * 5%

AUTO MECHANIC N = 201

(Correlations adjusted for restriction of range on N 2052.)

Test	M	σ	r_{bis}
Army General Classification Test			
Arithmetic	32.0	8.25	.36**
Blocks	30.0	7.13	.40**
Guilford-Zimmerman Aptitude Survey			
Part 4 - Perceptual Speed	38.4	8.98	.24**
Part 7 - Mechanical Knowledge	34.5	8.38	.20**
Validity Check N = 201			.46**
Other significant tests: Industrial Psychology Memory	32.6	10.97	.19**
AGCT Verbal	25.1	7.51	.23**
G-Z Part 5, Spatial Orientation	17.1	9.18	.22**

BODY AND FENDER REPAIR N = 115

Test	Correlation
(Correlations corrected for restriction of range on N = 957)	
Dexterity - Coordination of both hands:	
Guilford-Zimmerman Aptitude Survey	
Part 4 - Perceptual Speed	
Part 7 - Mechanical Knowledge	
SRA Mechanical Aptitudes	
Shop Arithmetic	
Army General Classification Test	
Blocks	
Minnesota Revised Paper Form Board	
Validity Check N = 115	r_{bis} .33**

CHEF TRAINING N = 113

Test	$\bar{X}$	σ	Correlation r_{bis}
Army General Classification Test			
Arithmetic	53.1	7.90	.59**
Blocks	53.1	8.20	.57**
Guilford-Zimmerman Aptitude Survey			
Part 4- Perceptual Speed	52.8	14.0	.37**
Guilford-Zimmerman Temperament Survey			
'F' Factor	49.8	5.32	.21**

Correlation: Total Battery R .65

OFFSET PRESS N = 80

Test — Validity Check r_{bis} .55

Test	Correlation r_{bis}
Dexterity - Assembly of Small Objects	.49*
Guilford-Zimmerman Aptitude Survey	
Part 4 - Perceptual Speed	.39
Progressive Matrices	.33
Army General Classification Test	
Blocks	.52
Industrial Psychology - Factored Aptitude Series	
Memory	.29
Farnsworth-Munsell 100 Hue Test of Color Vision (Error Score)	-.43

Note: Color test is used as a separate cutoff score and is not included in the total battery score.

Experimental Group

COSMETOLOGY N = 57 R .74 Test

	M	σ	Correlation r_{bis}
Progressive Matrices	43.8	7.7	.31
Graves Design Judgment	52.3	14.3	.22
Farnsworth-Munsell 100-Hue Test of Color Vision (error score)	32.2	24.8	-.29
Primary Mental Abilities			
Verbal	33.7	8.0	.47
Space	17.8	10.7	.27
Reasoning	14.4	5.5	.29
Number	21.4	9.4	.45
Word Fluency	48.0	14.6	.34
Guilford-Zimmerman Temperament Survey			
'G' Drive	17.8	5.7	.48
'P' Personal Relations	15.9	5.9	.33
Dexterity - Preferred Hand	63.5	5.6	.36

Validity Check N = 163 r.45

ELECTRONICS TECHNICIAN N = 55 Test

Significant Tests:	M	σ	Correlation (Corrected for restriction of range N = 621) r_{bis}
SCAT Quantitative	29.2	8.99	.25*
Progressive Matrices	43.4	7.45	.43**
Guilford-Zimmerman Aptitude Survey-Part 6			
Spatial Visualization	26.1	10.74	.35**
SRA Shop Arithmetic	10.6	2.89	.33**
PMA Reasoning	13.8	5.12	.28*
PMA Word Fluency	43.0	11.03	.38**

Battery
Matrices, G-Z 6, Shop Arithmetic, Word Fluency

Correlation: Total Battery R .68

FASHION DESIGN

Guilford-Zimmerman Aptitude Survey
Part 4 - Perceptual Speed
Part 5 - Spatial Orientation

Revised Minnesota Paper Form Board

Graves Design Judgment

Farnsworth-Munsell 100-Hue Test of Color Vision

Varnum Selective Art Aptitude
Tone (Color Value Perception)
Proportion

Validity Check r_t .53 N = 113

Validity Check

MACHINE SHOP N = 378	Test	M	σ	r_{bis}
	Correlations			
	Guilford-Zimmerman Aptitude Survey			
	Part 4 - Perceptual Speed	40.0	9.65	.20**
	Part 7 - Mechanical Knowledge	33.2	9.40	.40**
	Dexterity - Preferred Hand	62.1	6.24	.17**
	- Assembly of Small Objects	30.7	5.16	.14*
	Army General Classification Test			
	Vocabulary	25.7	7.41	.12*
	Arithmetic	32.1	9.82	.24**
	Blocks	29.9	5.95	.22**

Validity Check #2

MACHINE SHOP N = 69	M	σ	r_{bis}
Guilford-Zimmerman Aptitude Survey			
Part 4 - Perceptual Speed	41.7	11.44	.24*
Part 7 - Mechanical Knowledge	31.9	8.69	.56**
Dexterity - Preferred Hand	62.1	5.65	.11
Army General Classification Test			
Arithmetic	32.6	6.36	.38**
Blocks			.35**
Guilford-Zimmerman Temperament Survey			
"A" Ascendence			.33**
"O" Objectivity			.41**
"E" Emotional Stability	19.4	4.91	.42**

Battery:
- Perceptual Speed
- Mechanical Knowledge
- AGCT Arithmetic
- Temperament "E"; Dexterity Preferred Hand

Correlation: Total Battery R .75

MECHANICAL DRAFTING N = 66	M	σ	r_{bis}
Guilford-Zimmerman Aptitude Survey			
Part 6 - Form A	27.8	13.76	.29*
Progressive Matrices	48.2	5.33	.29*
Factored Aptitude Series "Memory"	37.9	9.43	.24*
Cooperative Mathematics 'Skills'			

Correlation: Total Battery R .48**

POWER SEWING

Guilford-Zimmerman Aptitude Survey
Part 4 - Perceptual Speed

Dexterity - Coordination of both hands

Revised Minnesota Paper Form Board

Industrial Psychology - Factored Aptitude Series- Blocks

Validity Check r_t .53 N = 155

RADIO AND TELEVISION SERVICE

Guilford-Zimmerman Aptitude Survey
Part 4 - Perceptual Speed
Part 6 - Spatial Visualization
Part 7 - Mechanical Knowledge

SRA Mechanical Aptitudes - Shop Arithmetic

Industrial Psychology

Factored Aptitude Survey - Memory

Validity Check r_{big}.40 N = 62

TECHNICAL ILLUSTRATION N = 252

Progressive Matrices
Graves Design Judgment
Revised Minnesota Paper Form Board

Guilford-Zimmerman Aptitude Survey
Part 5 - Spatial Orientation
Part 6 - Spatial Visualization

Guilford-Zimmerman Temperament Survey
'T' Factor

Primary Mental Abilities
Reasoning and Space

Validity Check r_{bis} .46

VOCATIONAL NURSING N = 58

	$\bar{X}$	σ	r_{bis}
California Achievement Test Form 'W' - Total Reading	8.1	17.80	.43**
Progressive Matrices	5.1	8.50	.28*
Guilford-Zimmerman Temperament Survey 'G' Factor - General Activity	8.4	3.50	.48**

Correlation: Total Battery R .58**

Note: Cutoff of 11.5 Grade Placement in Vocabulary used to refer to Remedial English.

We have been doing experimental work in setting up new batteries for selection of trainees in Restaurant Management, Plastics Technician, Metallurgical Technician and several Business fields, including Office Machines, File Clerk, Clerk-Typist and Business Data Processing.

The Metallurgical Technician battery developed by Mrs. Jean Gleis, Research Counselor, L.A. Trade-Tech College, is composed of five variables. Multiple R was .83 for a sample of 30 students completing training using theory grades as the criterion. The following experimental battery was used.

METALLURGICAL TECHNICIAN

COMPUTATION OF THE BATTERY

EXPERIMENTAL BATTERY

Test	Pearson Product-Moment Correlation Coefficients r
Guilford-Zimmerman Aptitude Survey	
IV - Perceptual Speed	.2699
VI - Spatial Visualization	.5598**
VII - Mechanical Knowledge	.3984*
Dexterity	
Preferred hand (Pin insertion)	.0813
Other hand " "	.0245
Both hands " "	.0036
Assembly	- .0353
Raven's Standard Progressive Matrices	.6837**
Minnesota Paper Form Board (15 minutes)	.6794**
*Guilford-Zimmerman Temperament Survey	
Rhythemia	.2304
Ascendance	.1633
Emotional stability	.1239
Objectivity	.1022
Friendliness	.0175
Personal Relations	.2864
(G, S, T and M not computed)	
SRA Primary Mental Abilities	
Verbal	.5409**
Space	.2224
Reasoning	.4743**
Number	.5275**
Word Fluency	.1324
Cooperative Math Skills Section, Grades 7,8,9	.5421**

**Significant at 1% level (r .463 or greater)
*Significant at 5% level (r .361 or greater)

CONVERSION CHART

METALLURGY

N = 30
Effective March 1965

Weighted Standard Scores M = 20 Converted Score	GZ VI Spatial Visualization Form B	Matrix	Minn. Paper Form Board (15 Minute) Rights Only	PMA Verbal	Coop. Math Grades 7,8,9
32			63 — 64		
31			61 — 62		
30		60	58 — 60		
29		58 — 59	56 — 57		
28		57 — 56	54 — 55		
27		55 — 54	51 — 53		
26		53 — 52	49 — 50		
25		51	46 — 48		
24	39 — 40	50 — 49	44 — 45		45
23	31 — 38	48 — 47	41 — 43	44 — 50	38 — 44
22	22 — 30	46 — 45	39 — 40	37 — 43	31 — 37
21	17 — 21	44 — 43	36 — 38	30 — 36	24 — 30
20	11 — 16	42 — 41	34 — 35	23 — 29	17 — 23
19	0 — 10	40	31 — 33	15 — 22	10 — 16
18	Below 0	39 — 38	29 — 30	8 — 14	3 — 9
17		37 — 36	27 — 28	1 — 7	0 — 2
16		35 — 34	24 — 26	0	
15		33 — 32	22 — 23		
14		31 — 30	19 — 21		
13		29	17 — 18		
12		28 — 27	14 — 16		
11		26 — 25	12 — 13		
10		24 — 23	10 — 11		
9		22 — 21	7 — 9		
8		20	5 — 6		
7		18 — 19	2 — 4		
6		16 — 17	0 — 1		
5		14 — 15			
4		12 — 13			
3		10 — 11			
2		9			
1		7 — 8			
0		5 — 6			
- 1		3 — 4			
- 2		1 — 2			
- 3		0			

Additional Testing for Research
GZ IV, Perceptual Speed

Total Battery Rating

High Third	104 and above
Middle Third	97 — 103
Low Third	80 — 96
Below Class	79 and below

A study of the correlations and intercorrelations suggested that the following variables would be the most predictive in combination with each other. (The Betas were developed using the Wherry-Doolittle method.)

Test Variable	Mean	Sigma	Beta	r
Progressive Matrices	41.97	6.52	.3587	.6837**
Revised Minnesota Paper Form Board (15 minute)	34.60	8.65	.3541	.6794**
Guilford-Zimmerman Aptitude Survey, Part 6, Spatial Visualization	18.33	12.88	.1027	.5598**
Cooperative Mathematics Grades 7,8,9, "Skills"	20.33	8.90	.1319	.5421**
S.R.A. Primary Mental Abilities - Verbal	25.87	10.34	.1408	.5409**

Multiple R was .83 (N = 30)

The raw scores of the experimental group were converted to standard weighted scores using the conversion chart from the formula $\frac{X - M}{\sigma}$ (B)(10) + 20 giving an average standard score of 20 for each factor. The total battery score for each student in the experimental group was found by adding the converted standard score on each factor. Percentiles were developed from these total battery scores. Cutting point for entrance was determined to be a battery score of 97 (the 33rd percentile).

In the Business fields the following batteries have just been completed: Typing, Filing and Office Machines.

Using available data from Metropolitan College, (Metropolitan College will be merged with Los Angeles Trade-Technical College as a Business Department of the college in July, 1966) a study was completed by Margaret De Nevers, Research Counselor, entitled "The Predictive Value of Different Ability Measures for Success in Selected Business Subjects" in August, 1965.

Predictive variables were SCAT Verbal, Quantitative and Total scores, DAT Abstract Reasoning, and twelve scores from the complete GATB (raw scores). Criterion variables were GPA in the following areas: typing, filing, office machines, shorthand, secretarial science, general business, total GPA in all courses, and age. The total number of subjects was 121. After a study of sample size, three sub-groups of typing (N = 80), Office Machines (N = 61), and Filing (N = 60) were chosen for study. A small group of shorthand students, N = 21, was also studied.

Results indicated that quantitative skills as measured by the SCAT, appeared to be better predictors than verbal skills for the areas of typing, filing and office machines. Results also indicated that the shorthand group may be more verbal than the other groups studied.

The abstract reasoning factor was found to be an important predictor in the filing area and there were some indications that this factor might be important in other areas as well.

With respect to the GATB raw scores, the best overall predictors seemed to be the computation and arithmetic reasoning tests. There was some indication that the name comparison test might have some general predictive value, while the vocabulary test was an important predictor for the area of filing. The three-dimensional space test had comparatively little predictive value but it seemed possible that a two-dimensional space measure might be more appropriate for the business areas. Tool matching, form matching, mark matching, and the dexterity tests of placing, turning, assembling, and disassembling had comparatively little predictive value for the areas studied. It seemed possible that a different measure of dexterity might be predictive. The relevant data are presented in the following tables.

TABLE I

MEANS AND STANDARD DEVIATIONS FOR BUSINESS GROUPS I AND II COMBINED

	Typing			Filing			Office Machines			Shorthand		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
SCAT												
Verbal	80	18.20	7.17	60	17.43	6.77	61	17.30	6.60	21	22.43	7.78
Quantitative	80	15.95	8.54	60	16.80	9.75	61	16.20	8.97	21	16.90	8.47
Total	80	34.15	13.16	60	34.23	15.09	61	33.49	13.07	21	39.33	14.05
DAT Abstract Reasoning	80	20.57	10.79	60	21.33	11.25	61	20.84	10.95	21	24.09	9.26
GATB												
Name Comparison	80	50.84	11.36	60	51.73	11.43	61	51.02	13.34	21	56.09	10.46
Computation	80	22.69	4.81	60	23.27	5.33	61	22.95	15.63	21	23.57	5.20
Three-dimensional space	80	13.06	4.20	60	13.33	4.55	61	13.31	3.98	21	15.43	4.72
Vocabulary	80	14.64	6.68	60	14.02	7.11	61	13.54	5.78	21	17.43	7.38
Tool Matching	80	29.02	5.54	60	29.56	5.73	61	29.57	5.53	21	32.67	4.18
Arithmetic Reason	80	8.77	2.62	60	8.83	2.91	61	8.54	2.61	21	9.43	2.69
Form Matching	80	26.51	6.02	60	27.32	6.70	61	27.92	4.35	21	25.23	6.22
Mark Matching	80	76.12	8.19	60	76.97	8.50	61	75.85	12.83	21	76.48	8.28
Place	80	87.75	7.27	60	88.83	7.03	61	89.21	7.19	21	87.67	6.48
Turn	80	104.34	8.27	60	103.73	8.36	61	104.21	8.58	21	100.67	7.04
Assemble	80	28.75	5.34	60	28.75	6.17	61	29.06	5.40	21	28.14	6.03
Disassemble	80	29.89	3.33	60	30.07	3.19	61	30.28	3.59	21	29.86	3.63

TABLE II

CORRELATION COEFFICIENTS FOR TYPING GROUPS I AND II COMBINED

Test	Pearson Product-Moment Correlation Coefficients				
	r Typing GPA	r Total Sec.Sci. GPA	r Total Business GPA	r Total GPA	r Age
SCAT					
Verbal	.2807*	.2880*	.3633**	.5282**	.3289**
Quantitative	.4405**	.4865**	.5652**	.6184**	.0395
Total	.4386**	.4724**	.5644**	.6887**	.2047
DAT Abstract Reasoning	.3462**	.3971**	.4182**	.4884**	-.0488
GATB					
Name Comparison	.3174**	.2425*	.2397*	.2996*	.0953
Computation	.5162**	.4923**	.5491**	.5472**	.0565
Three-dimensional Space	.1958	.2433*	.2771*	.2908*	.0638
Vocabulary	.2285	.2963*	.3370**	.4762**	.2047
Tool Matching	.2045	.1929	.2153	.2961*	-.1280
Arithmetic Reasoning	.3960**	.4129**	.4465**	.5140**	.0422
Form Matching	.2221**	.2611*	.3048**	.3129**	.1211
Mark Matching	.2179	.1927	.2095	.1830	-.0568
Place	.0493	.0812	.0123	-.0473	.0799
Turn	.0354	-.0064	-.0228	-.0127	.0157
Assemble	.1203	.0832	.0358	.1158	.0724
Disassemble	.2451*	.2304*	.2112	.2127	-.1208

N=80

* Correlations significant at 5% level.
** Correlations significant at 1% level.

TABLE III

CORRELATION COEFFICIENTS FOR FILING GROUPS I AND II COMBINED

Test	Pearson Product-Moment Correlation Coefficients				
	r Filing GPA	r Total Sec.Sci. GPA	r Total Business GPA	r Total GPA	r Age
SCAT					
Verbal	.5998**	.4564**	.5596**	.6499**	.3460*
Quantitative	.5159**	.5583**	.6349**	.6531**	.2285
Total	.6297**	.5861**	.6866**	.7431**	.3186*
DAT Abstract Reasoning	.4884**	.5241**	.5274**	.4752**	-.0132
GATB					
Name Comparison	.2216	.3532*	.3997**	.3235*	.1458
Computation	.4082**	.5724**	.6204**	.6033**	.2809*
Three-dimensional Space	.2262	.2661	.3136*	.3058*	.2179
Vocabulary	.4680**	.4177**	.5322**	.6113**	.3207*
Tool Matching	.3476*	.4254**	.3968**	.3625**	-.1672
Arithmetic Reasoning	.4616**	.5437**	.6153**	.6733**	.2939*
Form Matching	.1661	.3732**	.3760**	.3739**	.1982
Mark Matching	.1522	.3464*	.3780**	.3679**	.0367
Place	-.0385	.1735	.0337	.0580	.2074
Turn	-.1814	.0642	-.0125	.0292	.1444
Assemble	.0874	.2912	.1977	.2727	.0653
Disassemble	.2658	.4076**	.3878**	.3764**	.2971*

B-60

* Correlations significant at 5% level.
** Correlations significant at 1% level.

TABLE IV

CORRELATION COEFFICIENTS FOR OFFICE MACHINES GROUPS I AND II COMBINED

Test	Pearson Product-Moment Correlation Coefficients				
	r Office Machines GPA	r Total Sec.Sci. GPA	r Total Business GPA	r Total GPA	r Age
SCAT					
Verbal	.3940**	.3051*	.4241**	.1676	.4060**
Quantitative	.6362**	.4982**	.5982**	.3180*	.0760
Total	.6367**	.4969**	.6258**	.3033*	.2577
DAT Abstract Reasoning	.4609**	.3929**	.4215**	.3204*	-.0434
GATB					
Name Comparison	.3069*	.2972*	.3103*	.0188	.0698
Computation	.6058**	.5651**	.6565**	.2995*	.0598
Three-dimensional Space	.3771**	.2226	.2716	.1447	.0920
Vocabulary	.3531*	.2993*	.4003**	.3087*	.2679
Tool Matching	.1788	.1833	.1743	-.0270	-.1268
Arithmetic Reasoning	.6856**	.5088**	.6002**	.3679**	.1270
Form Matching	.3541**	.3287*	.3672**	.2132	.1230
Mark Matching	.2552	.2914*	.2999*	.0624	-.0599
Place	-.0151	.2288	.0813	.0668	.0426
Turn	-.0103	.0151	-.0379	.0738	-.0233
Assemble	.0617	.1334	.0388	.1335	.0708
Disassemble	.2725	.3032*	.2538	.1323	-.1021

* Correlations significant at 5% level.
** Correlations significant at 1% level.

TABLE V

CORRELATION COEFFICIENTS FOR SHORTHAND GROUPS I AND II COMBINED

Test	Pearson Product-Moment Correlation Coefficients				
	r Shorthand GPA	r Total Sec.Sci. GPA	r Total Business GPA	r Total GPA	r Age
SCAT					
Verbal	.3399	.3932	.4323	.4323	.6085**
Quantitative	.3348	.3482	.4942*	.5731**	.1276
Total	.3888	.4264	.5354*	.5826**	.4137
DAT Abstract Reasoning	.4308	.4702*	.4781*	.5099*	-.0156
GATB					
Name Comparison	.2283	.2973	.3688	.3956	.0772
Computation	.4095	.4456*	.4644*	.5007*	.1091
Three-dimensional Space	.1112	.1592	.2266	.2364	.2871
Vocabulary	.3616	.3581	.4236	.4842*	.5315*
Tool Matching	.1080	-.0138	-.0081	.0939	-.1088
Arithmetic Reasoning	.1889	.2396	.3718	.4488*	.2340
Form Matching	-.0157	-.0125	.0404	.0649	.2078
Mark Matching	.3609	.3844	.4402*	.4087	.2208
Place	-.0218	-.1798	-.1759	-.1405	.0615
Turn	.0850	.0357	.0452	.0284	.3346
Assemble	-.0131	-.0742	-.0507	.0615	.1803
Disassemble	.2348	.2436	.2803	.3153	.0362

* Correlations significant at 5% level.
** Correlations significant at 1% level.

The preliminary study was used as a guide in setting up experimental batteries for the selection of trainees for Filing, Typing and Office Machines, to be enrolled for the summer session 1966 and the fall semester of the school year 1966-67. A large number of test factors were administered to beginning classes in these areas in September, 1965. At the end of the semester, test scores were correlated with instructor grades. Following a study of the correlations and intercorrelations, aptitude test batteries were developed for each of the areas according to the procedures previously described. Results validated the results of the earlier study.

It was found that quantitative skills as measured by the SCAT were more predictive than verbal skills, although both correlated with grades in Filing. The abstract reasoning test was found to be predictive for Filing and Office Machines. The DAT Language Usage, Part I, Spelling, suggested by the earlier study, was found to be predictive in the areas of Typing and Filing. Perceptual Speed and Visual Speed and Accuracy were also indicated in Typing and Office Machines respectively. The dexterity of the Preferred Hand was found to correlate highly with typing skills.

The following batteries were developed with their conversion charts and battery ratings according to the procedures previously described:

Typing N = 49

Test	r	Variance
Dexterity (LATT test, both hands)	.59**	24%
DAT Language Usage Part I - Spelling	.48*	12%
SCAT Quantitative	.44*	9%
Guilford-Zimmerman Aptitude Survey Part IV-Perceptual Speed	.36*	3%

Multiple R = .70

Filing N = 26

Test	r	Variance
SCAT Quantitative	.53**	16%
SCAT Verbal	.43*	11%
DAT Part 6 (Abstract Reasoning)	.41*	9%
DAT Part I Language Usage (Spelling)	.26	2%

Multiple R .61

Office Machines N = 46

Test	r	Variance
SCAT Quantitative	.46**	17%
DAT Part 6 (Abstract Reasoning)	.40**	7%
Employee Aptitude Survey, Part 4 (Visual Speed and Accuracy)	.21	3%

Multiple R .52

Present computer hardware makes the statistical work in setting up or validating the batteries comparatively easy. In our original studies, where all work was done with the desk calculator, the work was considerable. We have used a program for the IBM 1620 which provides us with the ΣX, ΣX^2, and the correlations with the criterion and intercorrelations between independent variables for 25 test factors. From these we have computed Means, standard deviations, set up our intercorrelation matrix, chosen our trial batteries, developed our Beta weights using the Wherry-Doolittle method, and computed R and developed the conversion charts and percentiles for locating our battery ratings and cutting scores.

Later work using programs available for the Burroughs 5500 gave us a multiple correlation program and a step-wise multiple regression equation program providing the best possible combination of variables and the solving of the Beta weights concerned. We also have a program for handling the data relative to setting up the conversion chart using the formula:C score = $\frac{X-M}{\sigma}$ (B)(10)+20 (previously described). In actual practice, it would seem more economical to develop a program specifically tailored to the needs related to setting up the batteries. We would suggest inspection of the intercorrelation matrix and the pertinent correlations with the criteria followed by a tentative selection of variables for the battery and a program for the Wherry-Doolittle method which would develop the needed Betas and reproduce R. This should be followed by a program for the converted standard weighted scores used in the conversion chart. Conceivably the work of cutting cards and carrying out the computations could be easily accomplished in the same day.

This formalized method has been used to develop aptitude test batteries for some fifty-five different trade and technical curricula offered at the college. Some of these are more successful than others. We have been particularly successful in predicting in the mechanical fields and in some art fields.

Those areas where personality factors are critical, cause difficulty due to problems with criteria. A further problem is the subjective nature of the personality tests combined and high weightings of these variables in a battery caused by the low intercorrelation between personality test scores and ability scores. We need to use caution in these areas. Vocational nursing is a good example of this problem. Many studies of nursing aptitude show strong correlations with the theoretical part of the occupation

but little correlation with work in the wards. Nursing examinations are highly verbal and tend to stress reading comprehension and academic abilities. Work is being done in the area of vocational nursing. We are sorely in need of such studies.

We have done cross-validity studies in the fields of aircraft mechanics and cosmetology. In general, the same test factors are predictive. We found that the weightings of the factors will vary, due to differences in the criteria. We would hold with Cronbach, who states that "group factors hold only when regression equations are constructed about the criterion in a single institution". Super has said that "a battery of tests measuring relatively pure factors can be normed and validated for a great variety of occupations and for a great variety of curricula, and a given student's promise for a large number of fields can be appraised in a relatively brief testing session, at least in the institution in which the validity (regression) data are obtained," and further, "the tools (which the multifactor test batteries make available) are potentially the most useful but also the most complex we have had." We would agree.

I would like to present to you some of the tests from the core of some 21 tests in use in the development of our batteries. In general, they are standardized group tests. We do use two individually administered tests - one is an adaptation of the pegboard for dexterity testing. It consists of a board 18" by 24" scribed in the middle with 5 vertical rows of 20 holes per row on each side. Three small cups are located at the top of the board. The center cup contains small aluminum washers and the two cups at either side contain small aluminum rivets. The test consists of four parts. Timing for each part is 2 minutes. The test measures dexterity of the preferred hand, the other hand, the coordination of both hands, and the assembly of small objects.

We measure separately the number of pins for the right hand, the left hand, and both hands together. Then using both hands, the applicant makes an assembly of the rivets and washers, placing them in the holes on alternate sides of the board. This type of pegboard test allows for more testing time for each part than usual, and measures larger movement than the conventional pegboard test. The pegboards are made at the college. We would be glad to furnish specifications for making the boards and the standardized procedures upon request.

The other individual standardized test is the Farnsworth-Munsell 100-Hue Test of Color Vision. It is available through the Psychological Corporation. The test is untimed. It consists of four boxes of 82 small plastic discs covered with tinted paper comprising a color wheel. These are arranged by the applicant in a graduation of color changes according to small differences in the color samples. The test is of exceptional value in such areas as Offset Press (matching inks) and Costume Design (matching fabrics). The following group tests are used:

1. Perceptual Speed - Guilford-Zimmerman Aptitude Test Survey, Part 4
   Ability to see details quickly and accurately.
2. Spatial Orientation- Guilford-Zimmerman Aptitude Survey, Part 5
   Ability to relate oneself to an object spatially. This is of use in aptitude for working on machinery, reading blueprints, visualizing routes for cables-electrical maintenance and dress design.
3. Mechanical Knowledge- Guilford-Zimmerman Aptitude Survey, Part 7
   Ability to understand the uses of tools and interest in mechanical things.
4. Spatial Visualization-Guilford-Zimmerman Aptitude Survey, Part 6
   Ability to visualize moving objects.

5. Army General Classification Test, Civilian Edition - Verbal, Arithmetic and Blocks - separate part scores.

6. Primary Mental Abilities. Verbal, Space, Reasoning, Number and Word Fluency Factors - separate part scores.

7. Design Judgment (Graves). Ability to recognize good design.

8. Revised Minnesota Paper Form Board. Ability to visualize objects in two dimensions.

9. Guilford-Zimmerman Temperament Survey. Ten bipolar personality traits - 20 factors.

10. Engineering and Science Aptitude Test - separate part scores

11. Industrial Psychology - Blocks (Space visualization)

12. Progressive Matrices (Raven). Non-verbal reasoning.

You will note from our test scheduling for all of the batteries that there is considerable overlapping of tests administered in the different trade-technical areas.

In general, we find that we are able to do a better job in predicting areas requiring mechanical intelligence. We have had trouble in predicting successful ward performance among vocational nurses. We have had trouble using the speeded PMA with some of our people of limited verbal backgrounds, and in some areas such as Commercial Art, where a certain level of achievement is required, we have been unable to use a standardized test of art achievement and have been forced to develop and standardize our own test for this purpose.

Our cross-validity studies suggest that the variables in our test batteries may be predictive of success at other institutions. We have cross-validated our aircraft mechanic battery on 426 students using scores of apprentice trainees from Lockheed and Convair, students from Chaffey College, Mount San Antonio College, O'Connell Trade-Technical Institute, Oakland City College,

Laney Campus, San Jose High School, San Jose Junior College and San Jose State College, Reedley and San Diego Colleges. In general, we have found similar factors to be predictive: namely, reasoning, spatial visualization, mathematics achievement, perceptual speed, et cetera. The weighting of the factors in a battery, of course, will vary due to the variability of the criteria. We have attempted some work in objective performance testing in this area but it is slow and expensive work. Until these data are available, weighted battery scores should be developed within the individual institution or the batteries now in use at least be validated on groups within each institution. I have for your use some profiles developed from our aircraft mechanic cross-validation study and from an auto mechanic trainee study, N=201, corrected for restriction of range on 2000 applicants.

We have cross-validated our Cosmetology battery with cosmetology trainees at Riverside College; again, similar factors of intelligence were found to be predictive of success.

We feel uneasy about the inclusion of personality factors in the batteries. Our cross-validities have shown great variability in predictors and in that the low intercorrelations found between ability and personality scores may result in heavy weightings of the personality variables in a battery, a word of caution is due.

The need to assist our students to make wise vocational choices has been complicated by the ever-increasing numbers of young people knocking on our college doors and the need to train our people for more highly skilled technical fields in the face of automation-caused change. We offer the thesis that the multifactor approach to the construction of aptitude test batteries designed to predict successful trainability in specific fields is an economical and

justifiable approach and is at least one answer to that big problem - the identification of potentially satisfying life work within the capability limits of the human being we are trying to help.

GROUP	N	G-E 4	G-E 6	G-E 7	SHOP ARITH.	PRIMARY MENTAL ABILITIES V	S	R	M	N	MA-TRICES	G-S TEMPERAMENT SURVEY C	R	A	S	E	O	F	T	F	M	TOTAL BATTERY SCORE	σ r or σ p
Chaffee College	51	-.0637	.4088 **	.2955 *	.0411	.2393 *	.0600	-.0078	.0692	-.1187	.3437 *	-.0662	.0600	.0873	-.1127	.2048	-.3417 **	.0283	.1630	-.0114	-.0173	r .1641	σ_r .10
Convair Supervisor Rating	14	.3176	-.1186	.0604	.1121	.3165	5176	.1220	.1473	.4275	.3615	.1890	-.1363	.6385 *	.3978	.4429	.5363	.4846	.1099	.4560	.4220	p .4451	σ_p .23
Convair Instructor Rating	14	.2714	-.1890	.2011	.3429	.3319	5308	.0890	.1165	.4033	.3132	-.2484	-.0549	.3989	-.1429	.1703	.4286	.3857	.0945	.4626	.3934	p .4561	σ_p .23
Laney Trade-Tech Institute	26	.1295	.3617	.4164 *	.2148	.0304	.0840	.2351	.1145	.0206	.3470	-.1192	.1678	-.0022	.0485	-.0608	.4017 *	.2801	.0783	.3298	.1690	r .4038 *	σ_r .17
Lockheed Supervisor Rating	16	5772 *	.3170	.2551	.7632 **	.0287	.7713 **	.3934	.0176	.0584	.6765 **	.3257	.0875	.1044	.2022	.1213	.4588	.5863 *	.2044	.2213	.0030	p .6875 **	σ_p .14
Lockheed Instructor Rating	16	-.0830	.2532	.6265 *	.7111 **	-.0963	.6625 **	.2905	-.1416	-.1691	.3368	.1581	.1405	.1324	.0817	.1658	.2305	.3148	.2971	-.0252	.3148	p .3449	σ_p .24
Los Angeles Trade-Tech Junior College	119	.1804	.8775 **	.3366 **	.2626 **	.1856 *	.2933 **	.2887 **	.0660	.2142 *	.3751 **	.0005	.0760	-.1215	-.1109	.0261	.1689	.1254	.0193	.0518	.2793 **	r .3676 **	σ_r .08
Mt.San Antonio College	34	.0372	.3021	.4071 *	.1519	.1626	.3297	.6877 **	-.1029	.1807	.1346	-.4897 **	-.1622	-.3449	-.3745 *	-.0308	-.0189	.1676	-.0156	-.0914	-.0312	r .1849	σ_r .17
San Diego Voc. School and Junior College	12	-.2919	.6312 *	.6382 *	.4861	.8410 **	.2448	.2186	.0035	.6014	.7151 *	-.3881	.3340	-.3776	-.1889	.0000	.5298	.4406	.2728	.4756	.5455	p .5927	σ_p .20
John A. O'Connell Trade-Tech Institute	25	.0507	.3665	.6309 **	.3681	.2404	.0752	5302 **	.3650	.2930	.2735	-.1770	.0777	-.3220	-.3104	-.1404	.1610	.2833	-.1627	.2219	.1232	r .4368 *	σ_r .17
Reedley College	33	.0391	.1467	.3388	.2439	.5866 **	-.0150	.1689	.0855	-.0024	.0253	.1267	.0959	.2665	.1635	.2265	-.0715	-.0929	.0596	-.1251	.4103 *	r .2664	σ_r .16
San Jose Junior College	19	.2706	.2323	.1851	--	.6274 **	.3909	.3182	.2951	.3565	.2239	.2207	.3464	.2486	.1311	.4507	.4722 *	.3064	-.2738	.5103 *	.2902	--	--
San Jose State College	16	-.2544	.4177	.6132 *	.1485	.1360	-.0287	-.1831	.1405	.3735	-.1173	-.0174	.4787	.0596	-.6927 **	.1449	-.0290	-.0728	.1265	-.3272	.3941	p .4816	σ_p .21
San Jose Technical High School	16	-1240	.2062	.6619 **	.0365	.1798	-.0788	-.4010	.2738	.1920	-.0581	-.4720	.4373	-.0786	-.5741 *	-.0531	.0337	.2148	.4339	.4074	-.1398	r .3710	σ_r .22

N -380

el of Significance
* 5% ** 1%

TABLE XII

CORRELATIONS: APTITUDE TEST SCORES AND TEACHER AND SUPERVISOR RATINGS
AIRCRAFT POWER PLANT TRAINEES

Table XIV

AIRCRAFT POWER PLANT TRAINEES
INTERCORRELATIONS BETWEEN APTITUDE TEST FACTORS
LOS ANGELES TRADE-TECHNICAL COLLEGE (N - 119)

No.	Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	G-Z 7	—	.1046	.3508	.3593	.4638	.2751	.2138	-.0012	.3585	.3016	-.0060	.1388	-.0788	.0377	.0885	.1357	.0695	.2268	.2164	.2122
2	G-Z 4	—	—	.4566	.3731	.1077	.4047	.6063	.3920	.2975	.4410	.1756	-.2300	-.1077	-.1474	-.1415	-.0985	-.1570	.0117	-.1689	.1024
3	Shop Arith	—	—	—	.5951	.5685	.3672	.6269	.4991	.3326	.4864	.0178	-.0983	-.0882	-.0764	.0284	.1939	.0023	.0247	.1109	.1951
4	G-Z 6	—	—	—	—	.3833	.4113	.5884	.2809	.2282	.5628	.1015	.0250	-.0430	-.0084	.0359	.0971	.0973	.2430	.0967	.2653
5	Verbal	—	—	—	—	—	.3227	.5162	.4439	.4928	.3416	.0610	-.1501	.0934	.0031	.0017	.1339	-.2157	.1905	.1726	.3469
6	Space	—	—	—	—	—	—	.4017	.2267	.3090	.0123	.2478	-.0218	.1349	.1192	-.0848	-.1046	-.1567	.0744	-.0834	.1796
7	Reasoning	—	—	—	—	—	—	—	.4210	.3850	.5661	.0602	-.2022	-.0579	-.0892	-.0102	-.0062	-.1394	.0402	.0109	.5082
8	Number Word	—	—	—	—	—	—	—	—	.4555	.2936	.0534	-.1193	-.0889	-.0221	-.0399	.0229	-.0526	-.0628	-.0398	.0530
9	Fluency	—	—	—	—	—	—	—	—	—	.0095	.0817	-.1310	.1145	.0397	.0252	.1060	-.0838	.1566	.0175	.2484
10	Matrix	—	—	—	—	—	—	—	—	—	—	.0602	-.1096	-.1224	-.1643	-.0532	-.0632	-.0692	-.0088	-.0265	.0980
	G-Z Temp.																				
11	G	—	—	—	—	—	—	—	—	—	—	—	.0297	.2966	.3121	.1018	-.0051	-.0565	-.0075	-.1533	-.0250
12	R	—	—	—	—	—	—	—	—	—	—	—	—	.1659	-.0368	.1486	-.1207	.4026	.2441	.1004	.1193
13	A	—	—	—	—	—	—	—	—	—	—	—	—	—	.7097	.2351	.2106	-.0436	.1369	.1180	.1073
14	S	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.4162	.3308	.2524	.1737	.2782	.0621
15	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.6633	.6007	-.0356	.3892	.2006
16	O	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.6398	.0479	.6004	.3265
17	F	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-.0044	.4093	.1542
18	T	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.1176	.1119
19	P	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.2556
20	M	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table XVII

AIRCRAFT POWER PLANT TRAINEES: COMPARISON OF CORRELATIONS BETWEEN CRITERIA AND TOTAL APTITUDE TEST BATTERY SCORES OBTAINED FROM ORIGINAL AND REVISED BATTERIES—ALL GROUPS

Group	N	Original Battery	Level of Significance	Revised Battery	Level of Significance	Comment
Chaffee	51	r .16 σ_r .10	Below 5%	r .28 σ_r .14	5%	Gain
Convair (Supervisor)	14	p .45 σ_p .23	Below 5%	p .38 σ_p .25	Below 5%	Loss
Convair (Instructor)	14	p .46 σ_p .23	Below 5%	p .37 σ_p .25	Below 5%	Loss
Laney Trade and Tech.	26	r .40 σ_r .17	5%	r .42 σ_r .20	5%	Slight Gain
Lockheed (Supervisor)	16	p .69 σ_p .14	1%	p .55 σ_p .19	5%	Loss
Lockheed (Instructor)	16	p .34 σ_p .24	Below 5%	p .81 σ_p .09	1%	Gain
L.A.Trade-Tech J.C.	119	r .37 σ_r .08	1%	r .51 σ_r .09	1%	Gain
Mount San Antonio	34	r .18 σ_r .17	Below 5%	r .27 σ_r .17	Below 5%	Slight Gain
San Diego	12	p .59 σ_p .20	Below 5%	p .70 σ_p .16	5%	Gain
O'Connell Trade-Tech	25	r .44 σ_r .17	5%	r .25 σ_r .20	Below 5%	Loss
Reedley	33	r .27 σ_r .16	Below 5%	r .25 σ_r .18	Below 5%	Slight Loss
San Jose J.C.	19	——— Incomplete Data ———		r .55 σ_r .24	Above 5%	—
San Jose State	16	p .48 σ_p .21	Below 5%	p .008 σ_p .27	None	Loss
San Jose Tech. High	16	r .37 σ_r .22	Below 5%	r-.08 σ_r .26	None	Loss

LOS ANGELES TRADE-TECHNICAL COLLEGE
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PSYCHOMETRIC INVENTORY

	NORMS	TOTAL TIME	
VOCATIONAL INTEREST			
Lee-Thorpe California Occupational Interest Inventory-Advanced	H.S.,Adult	(40)*	NT**
Guilford-Schneidman-Zimmerman Interest Inventory	H.S.,Coll., Adult	(45)	NT
Strong Vocational Interest Blank for Men	Adult	(60)	NT
Strong Vocational Interest Blank for Women	Adult	(60)	NT
GROUP ABILITY			
Cooperative SCAT 15-20-10-25 minutes	H.S.,Coll., Adult	(85)	***
Army General Classification Test	Adult	40	***
California Achievement Test, Form W-Advanced Reading 66, Math 62, Language 38 minutes	H.S.,Coll.	166	***
Langmuir Oral Directions	Adult	(30)	
Primary Mental Abilities 4-5-6-6-5 minutes	H.S.,Adult	(45)	***
Progressive Matrices (Raven)	Adult	30	
Engineering and Physical Science Aptitude Test Math 15, Formulation 10, Comprehension 10, Arith. Reas. 15, Verb. Compr., 10, Mech. Compr. 12	H.S.,Coll., Adult	72	***
SPECIAL AREAS			
Design Judgment	H.S.,Art School, Coll., Adult	(30)	NT
Dexterity Pegboard Test (Original Test)	H.S.	(20)	***
Pin Insertion, Preferred Hand 2 minutes			
Pin Insertion, Other Hand 2 "			
Pin Insertion, Both Hands 2 "			
Assembly of Pins and Washers 2 "			
Differential Aptitude Test	Coll., Adult		
Part 6, Abstract Reasoning		25	
L.U. Part 1, Spelling		10	

* Brackets indicate estimated total time
** NT indicates tests not timed
*** Indicates Part Scores available

SPECIAL AREAS continued

	NORMS	TOTAL TIME	
Employee Aptitude Survey	Coll., Adult	(80)	***
Part 1 Verbal Comprehension — 5 minutes			
2 Numerical Ability — 10 "			
3 Visual Pursuit — 5 "			
4 Visual Speed-Accuracy — 5 "			
5 Space Visualization — 5 "			
6 Numerical Reasoning — 5 "			
7 Verbal Reasoning — 5 "			
8 Word Fluency — 5 "			
9 Manual Speed, Accuracy — 5 "			
10 Symbolic Reasoning — 5 "			
Factored Aptitude Series			
Memory — 6 minutes	H.S., Coll., Adult	(12)	
Blocks — 5 "	H.S., Coll., Adult	(10)	
Farnsworth-Munsell 100-Hue Test of Analogous Color Vision	Coll.		NT
Guilford-Zimmerman Aptitude Survey	H.S., Coll., Adult		
Part 4 Perceptual Speed		5	
Part 5 Spatial Orientation		10	
Part 6 Spatial Visualization		10	
Part 7 Mechanical Knowledge		(30)	NT
Programmers Aptitude Test	Coll., Adult	60	
Revised Minnesota Paper Form Board	H.S., Coll., Adult	15 - 20	
SRA Mechanical Aptitudes	Gr 9-12	(45)	***
Mechanical Knowledge — 10 minutes			
Space Relations — 10 "			
Shop Arithmetic — 15 "			
Still-Life Drawing Test (Original test)		30	
Varnum Art Aptitude	Coll., Adult		
Color Sensitivity		(5)	NT
Proportion		(5)	NT
Numerical			
Cooperative Mathematics Grades 7,8,9 Skills (only)	Grades 7-9 H.S.,Coll.	30	
Cooperative Mathematics Pre-Test for College Students	Coll., Adult	40	
DAT Numerical	Grades 8-12 Coll., Adult	30	
Personality			
Guilford-Zimmerman Temperament Survey	Coll., Adult	(45)	NT
MMPI (Research purposes only)			NT